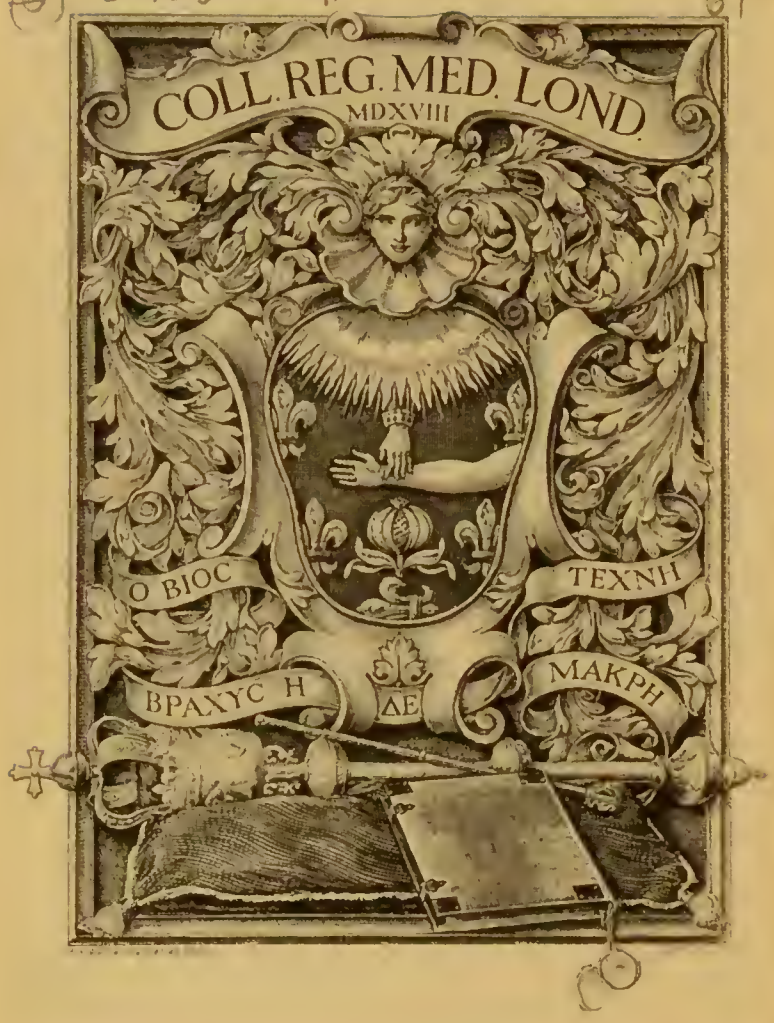
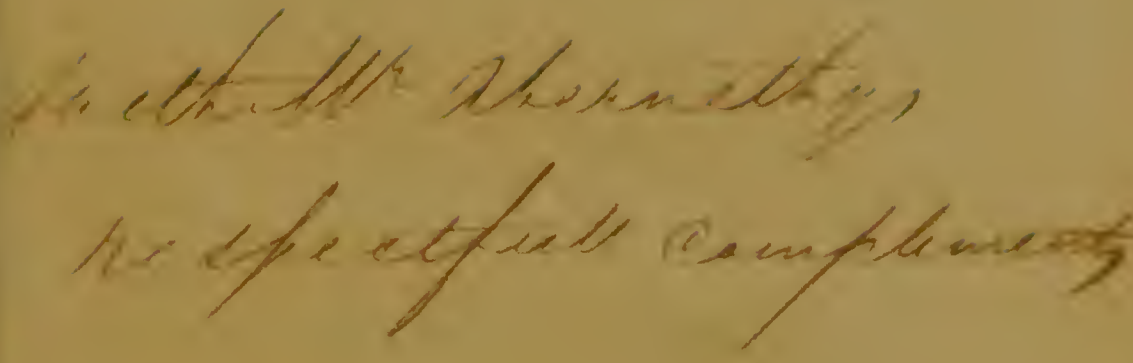




AN ENQUIRY, &c.

AN

ENQUIRY

INTO THE

PROBABILITY AND RATIONALITY

OF

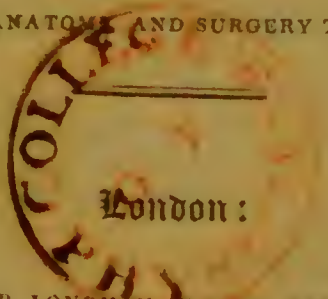
MR. HUNTER'S

THEORY OF LIFE;

BEING THE SUBJECT OF THE FIRST TWO ANATOMICAL LECTURES DELIVERED BEFORE THE ROYAL COLLEGE OF SURGEONS, OF LONDON.

By JOHN ABERNETHY, F.R.S. &c.

PROFESSOR OF ANATOMY AND SURGERY TO THE COLLEGE.



London:

PRINTED FOR LONGMAN, HURST, REES, ORME, AND BROWN, PATERNOSTER-ROW.

1814.

H. Bryer, Printer, Bridge-Street, Blackfriars, London.

LECTURE I.

In succeeding Sir William Blizard in the honorable office of Professor of Anatomy and Surgery, I think it right to inform my audience that he was my earliest instructor in these sciences; and that I am greatly indebted to him for much and most valuable information respecting them. My warmest thanks are also due to him for the interest he excited in my mind towards these studies, and for the excellent advice he gave me, in common with other students, to direct me in the attainment of knowledge.

"Let your search after truth," he

would say, "be eager and constant. Be wary in admitting propositions to be facts before you have submitted them to the strictest examination. If, after this, you believe them to be true, never disregard or forget any one of them, however unimportant it may at the time appear. Should you perceive truths to be important, make them motives of action; let them serve as springs to your conduct."

"Many persons," he remarked, "acknowledge truth with apathy; they assent to it, but it produces no further effect on their minds. Truths, however, are of importance, in proportion as they admit of inferences which ought to have an influence in our conduct; and if we neglect to draw those inferences, or to act in conformity to them, we fail in essential duties."

Our preceptor further contrived by various means to excite a degree of enthusiasm in the minds of his pupils. He displayed to us the *beau ideal* of the medical character:—I cannot readily tell you how splendid and brilliant he made it appear;—and then, he cautioned us never to tarnish its lustre by any disingenuous conduct, by any thing that wore even the semblance of dishonour. He caused the sentiment of the philanthropic Chremes, in the Heautontimorumenos of Terence, to be inscribed on the walls of the hospital-surgery, that students should have constantly before them an admonition to humanity, drawn from a reflection on their own wants: Homo sum; humani nihil a me alienum puto.

I could with pleasure enlarge on this theme, but I check myself, because I am aware that what I am

now saying may rather annoy than gratify the feelings of my preceptor. What I have stated, however, is a tribute due from me to him; and I pay it on the present occasion, in hopes that the same precepts and motives may have the same effect on the minds of the junior part of my audience, as they were accustomed in general to have upon the pupils of Sir William Blizard.

That which most dignifies man, is the cultivation of those intellectual faculties which distinguish him from the brute creation. We should indeed seek truth; feel its importance; and act as the dictates of reason direct. By exercising the powers of our minds in the attainment of medical knowledge we learn and may improve a science of the greatest public utility. We have need of enthusiasm, or of some strong incentive, to induce

us to spend our nights in study, and our days in the disgusting and health-destroying avocations of the dissecting room; or in that careful and distressing observation of human diseases and infirmities, which alone can enable us to understand, alleviate, or remove them: for upon no other terms can we be considered as real students of our profession. We have need of some powerful inducement, exclusively of the expectation of fame or emolument: for unfortunately a man may attain a considerable share of public reputation and practice without undertaking the labours I have mentioned, without being a real student of his profession. I place before you the most animating incentive I know of to labour truly to acquire professional knowledge. You will by such conduct possess yourselves of the enviable power of being extensively useful to your fellow-crea-

tures, in a way the most necessary to their wants, and most interesting to their feelings. You will be enabled to confer that which sick kings would fondly purchase with their diadems; that which wealth cannot command, nor state nor rank bestow. You will be able to alleviate or remove disease, the most insupportable of human afflictions, and thereby give health, the most invaluable of human blessings.

I shall not, however, gentlemen, waste your time in expatiating on this topic, because you will feel much more than I can utter, and because all that can be said or thought of it, seems concentrated in one brief but enthusiastic sentence of Cicero, which therefore I quote. In nulla re, propiùs ad deos homines accedunt, quam salutem hominibus dando.

In occupying the situation of the last gentleman who taught in this place, Sir Everard Home, who has pursued the path of science which Mr. Hunter pointed out, with a considerable talent for observation, and with a degree of zeal and industry, scarcely to be expected from one whose time and attention have been otherwise so much engaged; I also, equally with him, feel interested in impressing on the minds of my audience, the advantages we have derived from the labours of Mr. Hunter, and from pursuing that mode of study and enquiry which he adopted, and inculcated: and I am desirous on the present occasion, to engage your attention in the consideration of the probability and rationality of his theory of life.

The term theory, in philosophical language, like hypothesis, denotes the most plausible and rational mode of accounting

for certain phænomena, the causes of which have not been fully developed. In applying these terms to medical and physiological subjects, I may be allowed to define what I think they designate, and what I intend to convey by them. By the word theory I mean a rational explanation of the cause or connexion of an apparently full or sufficient series of facts: by hypothesis, a rational conjecture concerning subjects in which the series of facts is obviously incomplete.

The formation of an hypothesis excites us to enquiries, which may either confirm or confute our conjectures; and which may, by enabling us to discover the deficient facts, convert our hypothesis into a theory. Believing the facts collected by the ingenuity and industry of Mr. Hunter, to be sufficient to establish his opinions respecting life, I have therefore called them, a theory.

There was a time when medical men entertained so determined a dislike to the word theory, that they could scarcely tolerate the term. If any such remain, I would beg them to reflect that hypothesis and theory are the natural and inevitable result of thinking; so that if they refuse to allow of any theory, they must prohibit all thought.

The antipathy which some have entertained to the term theory, has arisen from its misapplication. For opinions drawn from very partial views of subjects, sometimes having no foundation on facts; opinions formed by processes of mind, similar to those which occur in dreaming, when lawless imagination produces combinations and associations without any reference to realities; opinions, as unlike what I should understand by theory as darkness is to light, have nevertheless

been often proposed as theories and so denominated. That such foolish speculations, such waking dreams, will mislead and deceive us, cannot be doubted ; and hence has arisen the prejudice which some have entertained against the term.

The greatest philosophers were through the whole course of their enquiries and demonstrations, theorists. Theorizing, according to my conception of the word, means nothing more than thinking correctly, in a concatenated manner, and in conformity to rules which I shall presently have occasion to notice. It is scarcely necessary for me to assert that this kind of thinking is useful, and promotive of Science. For was it not thinking in this manner on the cause of an apple falling from a tree, that led Sir Isaac Newton to ascertain the laws of attraction? was it not thinking thus which led him

to perceive that the operation of the same causes might perpetuate the regular motions of the planetary system? Why do we note facts with accuracy, or collect them with diligence? why do we interrogate nature by experiment? Is it not because we wish to prove some of our own opinions to be true, or the opposing opinions of others to be false? or, because we wish to enlarge the boundaries of science in a direction in which we think they admit of extension? What induces one person to prohibit another from theorizing? Is it not because he has himself attempted it in vain, and therefore deems the attempt unavailing?

Feelings and opinions are the chief sources of all our intellectual conduct: we ought therefore to cultivate good and honorable feelings, and to scrutinize opinions, with a view to entertain none but those

that appear correct; and such an examination, to which I now invite you, must be allowed to be a proper exercise of intellect.

Since thinking is inevitable, our chief enquiry should be how we ought to think or theorize; and on this point Newton himself has condescended to instruct us. Our theories, hypotheses, or opinions, for to me all these words seem to refer to one and the same act of the mind—should be verifiable or probable, and should rationally account for all the known phænomena of the subject they pretend to explain; under which circumstances it is allowable to maintain them as good, until others more satisfactory be discovered. No man who thus theorizes need feel shame in this employment of his intellectual powers; no man can feel arrogance, for it is acknowledged that his theory is but a probable and rational conjecture.

Besides, we never can be sure, that the series of facts belonging to any subject is full or complete; new ones may be discovered, that would overturn our best established theories.

Upon the foregoing terms alone do I wish to uphold Mr. Hunter's theory of life; and I do so on the present occasion, because it seems highly probable, it was his thinking in the manner he was known to do, that caused him to survey all the facts connected with the subject of life in general with so much accuracy, as well as to note its disordered states and sympathies in a manner which has so greatly contributed to increase our practical knowledge. It is highly probable that it was his hypothesis respecting life which incited him to enquiries by which he has been able to supply the deficient facts, so as to establish his conjectures, or convert his hypothesis into a theory.

Mr. Hunter seems to have put us into a right path, and every step we take our prospects become more enlarged and distinct, and we evidently approximate to the ultimate object which we have in view.

Whoever duly reflects on the extent of human knowledge and power, cannot but feel an interest in anatomical enquiries; since he must perceive that it is by means of the organization of the body, the mind acquires all its information, and executes all its purposes. When, however, we engage in anatomical enquiries, we find so great a diversity of structure in the different parts of the body; so great a variety of expedients for effecting certain purposes, all so simple in their nature, yet so adequate to their intended design, that anatomy becomes highly interesting from the curiosity it excites, the knowledge it im-

parts, and the food for meditation it affords.

When also in the prosecution of our anatomical enquiries, we as it were analyze the body, or reduce it to its elementary parts; when we find that every organ, and every portion of it, is composed of a few and simple vessels, a few and simple fibres; that by these it is originally formed, kept in constant repair, endowed with animation, sensation, and motion; we become lost in astonishment that such important ends can be effected by apparently such simple means.

On reflecting how I might best accomplish the duty which devolves to me, of giving anatomical lectures in a place by no means suited to anatomical demonstrations, I thought I could not do better than speak of the structure and

functions of these elementary component parts of the body; since by this method I should be led to describe their natural and healthy structure and functions, which would be a proper introduction to the subsequent discussions I have to engage in, relative to the nature and treatment of disorder and disease. As it does not seem material which subject I consider first, I shall begin with the Fibres, the only visible means by which motion and sensation are produced; for this will lead directly to the consideration of Mr. Hunter's Theory of Life.

In surveying the great chain of living beings, we find life connected with a vast variety of organization, yet exercising the same functions in each; a circumstance from which we may I think naturally conclude, that life does not de-

pend on organization. Mr. Hunter, who so patiently and accurately examined the different links of this great chain, which seems to connect even man with the common matter of the universe, was of this opinion. In speaking of the properties of life, he says, it is something that prevents the chemical decomposition, to which dead animal and vegetable matter is so prone; that regulates the temperature of the bodies it inhabits, and is the cause of the actions we observe in them. All these circumstances, though deduced from an extensive contemplation of the subject, may, however, be legitimately drawn from observations made on the egg. A living egg does not putrefy under circumstances that would rapidly cause that change in a dead one. The former resists a degree of cold that would freeze the latter. And when subjected to the genial warmth of incubation, the matter of it begins to

move or to be moved so as to build up the curious structure of the young animal.

The formation of the embryon in gallinaceous ova was particularly attended to by Mr. Hunter; and he was of opinion, that motions began in various places in the cicatricula so as simultaneously to form parts of the embryon and its appendages.

The opinions of Mr. Hunter deserve at least to be respectfully and attentively considered. That he was a man of genius, according to the beautiful definition of that quality given by Dr. Johnson; that he possessed the power of mind that collects, combines, amplifies and animates, the energy without which judgment is cold, and knowledge is inert; cannot I think be doubted by

any one who has carefully considered his writings. That he was a man of uncommon industry, by which he collected abundance of facts, will be admitted by every one who has even beheld his museum. That he was a man of constant and deep reflection, is to me equally apparent.

Many persons have genius without industry; others industry without genius; and many who possess both are still deficient in judgment.

I here beg permission to explain the notions I entertain of that act of the mind by which we form our inferences, opinions, or judgments. I shall by this means at once unfold what it is that, in my estimation, gives currency and value to the opinions of any individual, and entitles them to the attention of others. The human mind has the power of hold-

ing, as it were, in review, a series of facts or propositions, and steadily contemplating them so as to arrange, assort, or compare them till we form some deduction respecting them. This power seems to belong exclusively to man, and is the basis of his reasoning faculty. That mind is the strongest which can contemplate the greatest number of facts or propositions with accuracy; and his judgments are generally the most correct, who omits to review none of the facts belonging to the subject under his consideration. It was this power of mind that so eminently distinguished Newton from other men. It was this power that enabled him to arrange the whole of a treatise in his thoughts, before he committed a single idea to paper. In the exercise of this power, he was known occasionally to have passed a night or day entirely inattentive to surrounding objects.

That Mr. Hunter was also a man of constant and deep reflection, that he possessed this enviable power of mind, so essential to the perfection of the intellectual character, is to me sufficiently apparent; for I know of no opinion of his that was lightly or loosely formed, or that was not logically and cautiously deduced from the facts before him: and though from the subsequent increase of knowledge, the validity of some of his opinions may now be doubted, yet most of them have from the same cause become more firmly established. With all his genius, knowledge, and reflection, Mr. Hunter was not, however, a brilliant character amongst us. He had not the happy talent of displaying the stores of his mind, nor of communicating to others the same perception of the importance of his facts and opinions as he himself entertained. Perhaps it may have arisen

from my attending more to his facts and opinions than to his mode of explaining them, that I have been led to form so high an estimate of his intellectual powers. I can draw no other inferences from the facts than those which he has drawn, and therefore am I a convert to his opinions.

I proceed now to consider the structure and functions of those fibres which constitute the muscles, in order to introduce the discussion of the probability and rationality of Mr. Hunter's Theory, as a cause of irritability. Muscular fibres are soft and readily lacerable in the dead body, and even during life when they are in a state of inaction. They are composed of that insoluble substance which we meet with in the blood, and which, from its disposition to concrete in a fibrous form, is called the fibrous part of that fluid. The threads and flakes

of common cellular substance, which connect the muscular fibres, and every where pervade the structure of a muscle, may be removed by boiling, and then the muscular fibres may be separated, till they become too minute to admit of further separation, and almost elude our unassisted sight. Yet there are some who assert, that by the aid of powerful lenses each fibre, though slender as the threads of flimsy gossamer, appears but as a muscle in miniature, being composed of a number of smaller fibres. There are others who maintain the contrary, and affirm that they can see the ultimate muscular fibres. It would seem to me a waste of time to detail to you the reports of various microscopical observers, respecting the ultimate fibres of muscles, since there is so little concurrence or certainty in their descriptions. The opinion which such contradictory statements have impressed

on my mind, is, that perhaps the ultimate arrangement of matter, like its ultimate particles, may form a subject too subtile for human perception. Our information in these respects must be limited, as our powers of perception have their bounds. The imperfection of the human senses does not, however, seem a subject of regret; because it induces a greater necessity for the exertions of intellect; and many subjects appear far more demonstrable to reason than to sense.

Fontana, it must be granted, possessed considerable talent in microscopical observations, for he says, that he could readily distinguish the nature of any animal substance, which might be placed on the field of his microscope, by regarding its ultimate fibres, and according to him the muscular fibres are much smaller than those of the nerves. Proscaska and others

assert, that the ultimate muscular fibres are continued throughout the whole length of a muscle. How marvellous, (could we but see it,) would such a slender thread appear, continued throughout the whole length of the human sartorius. Haller, however, affirms, that the fibres are not continued, but that one set terminating another begins. Suspecting that Haller employed the solar microscope on this occasion, as he says he had done on others, I examined muscular fibres with this instrument. Now though I place no confidence in my own observation, and think the subject unimportant as to any conclusion that may be deduced from it, yet I will tell you how a portion of a muscle appeared to me when magnified about 500 times. The fibres were slightly undulating, and one set terminating, another began: neither were the sets of fibres of considerable length. The mus-

cular fibres were connected by cross threads of common cellular substance.

Mr. Carlisle, in whose talents and accuracy we are all disposed to place confidence, in the Croonian Lecture, printed in the Philosophical Transactions for 1805, says, that he can distinctly see an ultimate muscular fibre, which he describes "as a solid cylinder, the covering of which is reticular membrane, and the contained part a pulpy substance irregularly granulated."

He has also described the termination of nerves in muscles. Muscles are liberally supplied both with blood vessels and nerves, but nothing peculiar is perceived in their distribution. We make them very red by injecting them, and we see numerous nerves entering their substance

at various places. Yet the vessels of some muscles are too minute to receive red blood or our coloured injections, so that redness though a common is not an essential character of muscle.

I here willingly relinquish the enquiry into the structure of those organs in which the irritable property chiefly resides, in order, in the next place, to speak of the principal phænomena of irritability.

Muscles have the power of contracting with surprizing celerity and force. It seems indeed wonderful that the biceps muscle of the arm, which in the dead state would be torn by the weight of a few ounces appended to it, shall in the living state be capable of lifting and sustaining more than 100 lbs. The matter in the muscle seems neither to be in-

creased nor diminished during its contraction, what is lost in length being gained in bulk. The voluntary contraction of muscles cannot be long continued; they become weary and painful, the contraction remits and recurs, causing a tremulous motion. Yet this phænomenon does not seem to be the effect of absolute inability, in the irritable property, to continue in action, for some muscles continue to act without experiencing fatigue. For instance, those of the jaws and back; for whenever they relax, the jaw drops, and the head and body fall forwards, as we see in persons who are going to sleep in a sitting posture. Certain sphincter muscles likewise remain in action without experiencing fatigue. Some sphincters also, I may add, are disposed to yield considerably without impatience; so that their irritability resembles that of those muscles which Bichât has considered as

a distinct class, and subservient alone to what he calls the organic life. The contractile power of muscles is also capable of remaining in vehement action for a great length of time, as we see in some cases of cramps, and still more in some cases of tonic tetanus,

Yet though the irritable power is not incapable of continued exertion, it seems evidently to be in general susceptible of fatigue, and inclines to be at rest. If we stimulate the muscles of a limb of a frog severed from the body, by voltaic electricity, the muscular actions are at first vivid and forcible, but they grow fainter and feebler on repeated excitement. Yet if we wait a little till they seem to regain their power, they become vivid and forcible as at first from the same degree of excitement. Such actions may be

excited at intervals for twenty-four hours, though with a gradual diminution in their power, after which, in general, they can be no longer excited, and then the muscles become permanently and rigidly contracted. The foregoing facts appear to me to shew the impropriety of the phrase, exhausted irritability, which is in common use to express our inability by the effort of our will to continue the actions of our voluntary muscles: it seems manifest that the irritability is not exhausted but fatigued.

The rigid contraction of the muscles after death, is the effect of irritability: it is its last act. A considerable force is required to overcome this contraction, or to bend the rigid limbs of the dead body, when it has recently taken place. The force required to effect this, gradually

diminishes till the muscles become quite pliant; and then, and not till then, does putrefaction ensue.

Mr. Hunter has known this last vital contraction to occur in parts severed from the body sixty hours after their separation, upon the removal of causes which had impeded the contraction before that period; a proof that life in a certain degree was still resident in the part. He observed that death produced by lightning, or large charges of electricity, or by certain kinds of injuries and diseases, prevented this contraction, and even the coagulation of the blood; and that putrefaction would in such cases very rapidly take place. From facts of this kind, as well as from many others, he drew an inference, which has not I believe been disputed, and therefore I need not enter into the discussion of it at length, that

the principle of life may in some instances be suddenly removed, or have its power abolished, whilst in general it is lost by degrees.

The contraction of irritability takes place in some animals in a very slow and gradual manner, and their muscles in general are incapable of sudden contraction. Yet though the action of their muscles is very slow, it is very powerful and very permanent. The American sloth, supports its weight for a very long time in one attitude by fixing its claws into the branches of trees; an act which would speedily weary muscles of an ordinary character. The muscles of the legs of birds that roost, seem to have a similar power of permanent contraction.

Mr. Carlisle has lately demonstrated a peculiar distribution of the arteries in the

limbs of these tardigrade animals, as they are called, and Doctor Macartney has shewn that a similar arrangement of vessels exists in the legs of fowls. Such a distribution of the arteries may be subservient without being essential to these modes of action.

In the human body we see instances of irritability exerting itself after the manner it does in general in tardigrade animals. If the iris had possessed the ordinary powers of muscles, and none else, it could not have remained, as it is known to do, permanently contracted in a strong light, and permanently dilated in a weak one. Indeed, an anatomist who is fond of tracing structure as connected with function, might readily persuade himself, that there is in the iris a distribution of arteries, similar to that which Mr. Carlisle has demonstrated in the limbs of

sloths. We find, however, that sphincter muscles in general have the power of continuing their contraction, though no peculiar distribution of vessels is discoverable in them. In the gall bladder, the function of which requires this slow but permanently acting irritability, in order to express its contents in small and equal quantities into the bowels, as the digested aliment passes into them, we discover no peculiar arrangement of arteries. Though we cannot excite any sudden contraction of that bag, yet we know that it can gradually reduce itself into a very small compass. The skin has every where this slow but permanently acting, and gradually relaxing irritability, the effects of which are most evident in lax and pendulous portions of it. Accordingly we sometimes observe the scrotum and prepuce condensed into a surprizingly small and very compact mass.

Thus have we even in the human body evidences of irritability acting in various modes, whilst we can equally perceive that in tardigrade animals some of their muscles act with celerity. In the Lori, of whose habits Vosmaer has given so interesting an account, and which manifested no signs of alacrity, save in eating the food that it liked, no stimulation nor injury could induce it to mend its pace, but it shewed its resentment of the attempt to make it perform impossibilities, by suddenly snapping at the stick or instrument with which it was goaded; and thus again demonstrated that the muscles of its jaw were endowed with an irritability of the more common character.

Having thus briefly described the principal phænomena of muscular action, for I forbear to notice others of less impor-

tance, I proceed to review the conjectures that have been formed as to the cause of these curious, sudden, and powerful contractions. Not to speak of exploded hypotheses, I trouble you only with those which are modern.

First, then, the contraction has been supposed to be the effect of some chemical change occurring in the part. This opinion is I think invalidated by the reiterated contractions which may be produced in the limbs of some animals when removed from the body, even during twenty-four hours, if excited by voltaic electricity, and consequently when no supply of materials can be supposed to exist within the limb, to produce such reiterated chemical changes. The opinion is still further refuted by observing, that these vivacious contractions will equally take place, upon the same excitement, in the exhausted receiver of an air

pump and in the open air. They may also be excited under water, under oil, in a great variety of gases; in short, under circumstances which exclude the presence of any chemical agent from without, to which such changes could reasonably be imputed.

Secondly. The contraction of irritability has been supposed to be a property of the muscular fibres. Properties are generally considered as permanent qualities. Thus, the property of gravitation is continually operating, equally when bodies remain at rest and when it produces motion in them, equally whilst I support this book in my hand, and when I suffer it to fall on the table. If, however, so curious an occasional property could belong to matter, we should naturally expect that it would belong to some peculiar quality, or arrangement of matter. But irritability is connected with matter of different quali-

ties and arrangements. The flesh of animals and that of fish are different in quality; the mucilaginous bladders which float in the sea differ from vegetables; yet all are irritable, or possess this power of occasional contraction. Though in general we find irritability connected with a fibrous structure, yet, if we may trust our senses, it is not so in every instance. In the hydatid, where no such structure is apparent even with the aid of lenses, we still have evidence of the irritability of life. If also, as I strongly suspect, the muscular fibres be not continued from one end of the muscle to the other, irritability could not in that case be considered as a property belonging to them, since any breach of continuity would completely frustrate the contraction of the whole muscle.

Thirdly, I proceed to enquire into Mr.

Hunter's opinion, that irritability is the effect of some subtile, mobile, invisible substance, superadded to the evident structure of muscles, or other forms of vegetable and animal matter, as magnetism is to iron, and as electricity is to various substances with which it may be connected. Mr. Hunter doubtless thought, and I believe most persons do think, that in magnetic and electric motions, a subtile invisible substance, of a very quickly and powerfully mobile nature, puts in motion other bodies which are evident to the senses, and are of a nature more gross and inert. To be as convinced as I am of the probability of Mr. Hunter's Theory as a cause of irritability, it is, I am aware, necessary to be as convinced as I am that electricity is what I have now supposed it to be, and that it pervades all nature. To obtain this conviction it is necessary that the facts connected with this

subject should be attentively considered; but for such an examination I have no time; neither would it be considered as suitable to the general design of these lectures.

Whatever notions philosophers may be pleased to form respecting matter in general, it does not appear to me that our physiological opinions can be affected by their decisions. Of the matter which for the most part presents itself to our notice, and is cognizable by the eye and touch, we know that it has a property called by Sir Isaac Newton *vis inertiæ*, an indisposition to move unless impelled to motion, and a disposition to continue in motion unless retarded.

There are some philosophers who think, that properties similar to those which in the aggregate mass become an

object of our senses, likewise belong to every atom of which it is composed; whilst others, on the contrary, think, that the atoms have very different qualities, and that the vis inertiæ is the property only of the aggregate mass. The matter of animals and vegetables is, however, an aggregate mass; it is as we express it, common matter, it is inert; so that the necessity of supposing the superaddition of some subtile and mobile substance is apparent.

Taking it for granted that the opinions generally entertained concerning the cause of electrical motions are true, analogy would induce us to suppose, that similar motions might be produced, by similar causes, in matter organized as it is found to be in the vegetable and animal systems.

The phænomena of electricity and of life correspond. Electricity may be attached to, or inhere, in a wire; it may be suddenly dissipated, or have its powers annulled, or it may be removed by degrees or in portions, and the wire may remain less and less strongly electrified, in proportion as it is abstracted. So life inheres in vegetables and animals; it may sometimes be suddenly dissipated, or have its powers abolished, though in general it is lost by degrees, without any apparent change taking place in the structure; and in either case putrefaction begins when life terminates.

The motions of electricity are characterized by their celerity and force; so are the motions of irritability. The motions of electricity are vibratory; so likewise are those of irritability. When by long continued exertion the power of

muscles is fatigued, or when it is feeble, their vibratory or tremulous motions are manifest to common observation, but the same kind of motion may be perceived at all times by attention, as has been shewn by Doctor Woolaston in the Croonian Lecture for the year 1810. It is then I think manifest, that Mr. Hunter's conjectures are the most probable of any that have been offered as to the cause of irritability.

My allotted time does not permit me at present to consider the other vital functions; yet I relinquish the subject with reluctance, because I have been speaking only on that point in which it seems most difficult to persuade the incredulous, of the probability and rationality of Mr. Hunter's Theory.

When hereafter I shall have to speak

of the other vital functions, I think it will appear that it is impossible to account for the phænomena in any other manner than that which Mr. Hunter has suggested.

In ascending the difficult and lofty ladder of knowledge, men of great talent and industry seem to have affixed to it certain resting places, on which, reposing for a time from their labours, they could tranquilly assemble their followers, and contemplate more extensive views of nature, and of nature's laws, than had before been taken. If after having stood by the side of the great teacher Newton, and learned from him the properties of common and inanimate matter, we afterwards attend to Mr. Hunter, our great instructor in the functions of living beings, he points out to us how matter, starting from the

general mass, springs up into life in vegetation. We see vegetables as it were self formed and producing their own species. We observe them also exerting most of the powers which animals possess. That they have irritability is evident from the current of their sap and their secretions; nay, in some we observe those vivacious motions which seem chiefly to belong to animal life, as is evident in the Mimosæ, the Dionæa Muscipula, and Heydysarum gyrans. We see them like animals having alternate seasons of action and repose; and though in general vegetables like animals are in action during the day and rest in the night, yet also some vegetables like some animals rest in the day and are in action during the common season of repose.

We see animals scarcely differing from vegetables in their functions, like them

doomed to a stationary existence, with even less appearance of organization than we usually discover in vegetables, and of a structure so simple as to admit of propagation like vegetables by cuttings. Yet in all the diversity of living beings we recognize certain processes peculiar and essential to life; as the power of converting other kinds of matter into that appropriate to the individual it is to form and support; the power of distributing the nutriment, thus converted, to every part for its formation and supply; the ventilation, as I may call it, of the nutritive fluids; the power of preparing various dissimilar substances from the nutritive fluids; and the propagation of the species. As what is deemed the complexity of animal life increases, we find distinct organs allotted for each of these functions; thus we have organs of digestion, circulation, respiration,

secretion, and generation, which are various in their structure in the different tribes of animals.

In vegetables, and in some moluscæ, no traces of nerves are discoverable. The nervous system begins in a simple form, and seems to increase in complexity up to man. But this will make the subject of the next lecture. Mr. Hunter also shews us that there are animals, as for instance the torpedo and gymnotus, which have organs liberally supplied with nerves, forming an electric battery which they can charge at will. Such facts shew to what a degree electricity exists in these animals, and how greatly it is under the influence or control of the nervous system; and they could not fail to make a strong impression on the contemplative and deeply meditating mind of Mr. Hunter.

What then, may I ask, is the natural inference to be drawn from the examination of this great chain of being, which seems to connect even man with the common matter of the universe? What but that which Mr. Hunter drew, that life must be something independent of organization, since it is able to execute the same functions with such diversified structure, and even in some instances with scarcely any appearance of organization at all.

The experiments of Sir Humphrey Davy seem to me to form an important link in the connexion of our knowledge of dead and living matter. He has solved the great and long hidden mystery of chemical attraction, by shewing that it depends upon the electric properties which the atoms of different species of matter possess. Nay, by giving to an alkali

electric properties which did not originally belong to it, he has been able to control the ordinary operations of nature, and to make potash pass through a strong acid, without any combination taking place. That electricity is something, I could never doubt, and therefore it follows as a consequence in my opinion, that it must be every where connected with those atoms of matter, which form the masses that are cognizable to our senses; and that it enters into the composition of every thing, inanimate or animate. If then it be electricity that produces all the chemical changes, we so constantly observe, in surrounding inanimate objects, analogy induces us to believe that it is electricity which also performs all the chemical operations in living bodies; that the universal chemist resides in them, and exercises in some degree peculiar

powers because it possesses a peculiar apparatus.

Sir Humphrey Davy's experiments also lead us to believe, that it is electricity, extricated and accumulated in ways not clearly understood, which causes those sudden and powerful motions in masses of inert matter, which we occasionally witness with wonder and dismay; that it is electricity which causes the whirlwind, and the water spout, and which "with its sharp and sulphurous bolt splits the unwedgeable and gnarled oak," and destroys our most stabile edifices; that it is electricity which by its consequences makes the firm earth tremble, and throws up subterraneous matter from volcanos.

When therefore we perceive in the universe at large, a cause of rapid and

powerful motions of masses of inert matter, may we not naturally conclude that the inert molecules of vegetable and animal matter, may be made to move in a similar manner, by a similar cause?

It is not meant to be affirmed that electricity is life. There are strong analogies between electricity and magnetism, and yet I do not know that any one has been hardy enough to assert their absolute identity. I only mean to prove, that Mr. Hunter's Theory is verifiable, by shewing that a subtile substance of a quickly and powerfully mobile nature, seems to pervade every thing, and appears to be the life of the world; and therefore it is probable that a similar substance pervades organized bodies, and produces similar effects in them.

The experiments of Sir H. Davy seem

to realize the speculations of philosophers, and to verify the deductions of reason, by demonstrating the existence of a subtile, active, vital principle, pervading all nature as has heretofore been surmized, and denominated the Anima Mundi. The opinions which in former times were a justifiable hypothesis, seem to me now to be converted into a rational theory.

It is then, I think, manifest, that Mr. Hunter's Theory of Life, presents us with the most probable solution of the phænomena of irritability, of any that has hitherto been proposed.

The human mind has been the same at all periods of the world; in all ages there have been men of a sceptical disposition, disinclined to believe any thing that was not directly an object of their senses. At allperiods there have been other men of a contem-

plative, and perhaps more credulous character, who have been disposed to believe that there were invisible causes, operating to produce the alterations which are visible, and who from much less numerous facts have drawn the same inferences that I have done. And many of these, from Pythagoras downwards, have expressed their sentiments, though with some variety, yet pretty much to the same effect. The Greek philosophers recognized in man, the Σωμα, Ψυχη, and Νους, the body, vital principle, and mind, whilst some used words significant of intellect, to express the energizing principle in nature, without apparently having any clear ideas of intelligence.

What was called the Anima Mundi, was, however, by many considered as a distinct and active principle, and was not confounded with intelligence of any kind. I know not how I can better exhibit to my au-

dience the subject I am alluding to, or better acquaint them with the general tenour and tendencies of these opinions, than by quoting that portion of these philosophical notions, which Virgil is said to have put into the mouth of Anchises,

Spiritus intus alit, totamque infusa per artus
Mens agitat molem, & magno se corpore miscet.

And please to observe, gentlemen, it is Virgil says, it is Anchises speaks, that which I also this day have been saying;—

Inde hominum pecudumque genus, vitæque volantum
Et quæ marmoreo fert monstra sub æquore pontus.

LECTURE II.

I proceed to speak of the structure and functions of the nervous fibres.

The nerves which we observe pervading the body, appear to be packets of very minute threads, seemingly distinct from each other. The nerves divide and subdivide, and in so doing a certain number of threads separate from the original packet, and appear as a distinct nerve. It is, therefore, possible to trace a minute nerve, up to its origin, from the toe or finger, by splitting it off from the various packets with which it has been conjoined. So far does anatomical fact concur with the physiological opinion,

that every nervous filament communicates distinctly with the brain or some process of that organ.

This apparent continuity is, however, lost, whenever we find those intumescences on nerves which are called ganglia, for in these there seems to be a mixture or consolidation of the nervous matter. It is also lost wherever various nerves unite together, and form a plexus; in which case the nervous fibrils either coalesce, or become inextricably interwoven with one another.

The nerve from which the thoracic and abdominal viscera are chiefly supplied, is beset with numerous ganglia and plexuses; and as we cannot by our will influence the actions of those viscera, and as the iris, the motions of which are also involuntary, is supplied with

nerves from a ganglion, it has been thought that ganglia, by intercepting the direct communications between the brain and the extreme branches of nerves, might render parts thus supplied less amenable to the will, and less under the influence of the general affections of the nervous system. It is also thought that ganglia might serve the office of subsidiary brains, each affording a separate source of nervous energy.

On the one hand, it ought to be observed, that all the vertebral nerves, supplying parts over which the will exerts the most perfect control, have ganglia at their commencement; and that the nerves of the leg and arm form a plexus near their origin. The actions of the cremaster muscle are involuntary; yet I believe it is supplied by the same nerves, which supply muscles that are subject to vo-

luntary actions; therefore this opinion does not appear to me to be such as we should receive with entire confidence. Again, it it is further apparent, that the functions of the abdominal and other viscera are greatly affected by disorders of the brain, and that the brain is greatly affected by disorders of these viscera.

The ingenious and industrious French anatomist, Bichât, has classed the living functions into the organic and animal: the distinction seems a natural and useful one, and throws light on the physiology of the visceral nerve. In vegetables, and in some moluscæ, no traces of a nervous system are discoverable. In some of the lower order of animals, that have organs for the preparation and distribution of nutriment, they are supplied by a visceral nerve, which it is probable maintains amongst those organs a con-

currence of impressions and actions. In some of these animals no traces of nerves subservient to the voluntary regulation of their motions can be found. In the ascending complexity of the nervous system, we find a nervous chord more or less beset with ganglia, which supplies other parts of the body besides the viscera, and which probably serves to maintain amongst them likewise a concurrence of impressions and actions. We next find at one end of this chord a kind of ganglion, or brain, which gradually becomes larger and more complex as we trace the series of links upwards to man, in whom it bears a much larger proportion to the nervous system in general than in any other animal. The visceral nerve, in the ascending series of animals, appears connected with the animal nerves; and so numerous are these connections that this nerve has in the human subject

obtained the title of the great sympathetic nerve.

The vital organs are required to carry on their functions with a degree of regularity and order, under the varying circumstances of life; and the possession of a distinct nerve may enable them to continue their functions without so materially participating in the disturbances of the animal system, as they must otherwise have done: yet the numerous connections of the visceral with the animal nerves must render both participators in each other's disorders.

The nerves, then, may be said to proceed from the brain, medulla spinalis, and visceral nerve, to all parts of the body for their supply. In thus expressing a fact, however, we should guard against an idea which the analogous distribution of

arteries is apt to engender. Arteries become minute in proportion as they send off branches, whilst on the contrary, the branches of nerves are often larger than the trunk from which they proceeded. It is no unfrequent occurrence for malformed children to be born without a brain, yet with a perfect nervous system. The most rational idea, therefore, we can entertain on the present subject, is, that the nerves are formed in the parts where we find them, and that they are connected to those parts of the organs from which we are accustomed to say they proceed. Nerves are vascular, and we can inject them with subtile injections.

The nerves, then, proceeding from, or being connected with the brain, medulla spinalis, and visceral nerve, may be traced, ramifying throughout the body in the manner already mentioned, till they arrive

at the part for the supply of which they are designed. They then split into numerous branches which communicate with each other, and again subdivide and rejoin, their communications appearing to multiply as they become more minute; so that every part of the body has a kind of net work of nerves, which is minute in proportion to the susceptibility and sensibility it possesses.

This general and imperfect sketch of the anatomy of the nervous system, relates only to what may be discovered by our unassisted sight. If by means of the microscope we endeavour to observe the ultimate nervous fibres, persons in general are as much at a loss as when by the same means they attempt to trace the ultimate muscular fibres.

Those fibres which we can split off

from a nervous packet, in the manner before mentioned, though too minute to admit of further subdivision, appear by the microscope to be themselves packets of smaller threads. It is generally asserted by microscopical observers, that the nerves and medullary matter of the brain and spinal marrow are the same, and are composed of very minute fibres. Fontana speaks confidently on this point; and he further says, that he has seen these nervous fibres regenerated in the medium which has been formed to unite a divided nerve. He describes the nervous fibres in every part of the nervous system as cylindrical, pursuing a slightly undulating course, and being in a considerable degree transparent. He states also that they are larger than the ultimate fibres of muscles.

Microscopical observers also tell us, that

though the nervous fibrils in each packet appear distinct, and may be separated from each other in the manner already described, yet they have nevertheless transverse communications with each other. Each nervous fibre has been supposed to be covered by investing membranes similar to those of the brain; but this opinion is founded on an analogy with what is observed in the optic nerve, rather than on actual observation with respect to others. That they have investing membranes is clear, and we are told that we may dissolve the medullary or nervous matter by an alkali, and leave these investing membranes; or on the other hand, that we may dissolve the investing membranes by nitric acid, and leave the medullary fibres.

Having thus spoken of the chief circumstances relating to the anatomy of

the nervous system, I shall not dwell on this part of the subject, but hasten to the principal object of the lecture, to consider its Physiology, in order to examine how far Mr. Hunter's Theory of Life, seems adequate to explain the phænomena of the nervous functions.

First then, it is generally believed that all sensation is in the brain, and that all volition proceeds from that organ. This proposition requiring to be impressed so as to produce conviction, for it is the foundation on which all our future reasoning is founded, I shall state the principal causes of this opinion. First, If the continuity of a nerve be intercepted at any point between that extremity which receives impressions from the objects of sense, and which therefore may be called the impressible or tangible extremity, and that which communicates with the brain,

and is usually called its sensorial extremity, both feeling and volition by means of that nerve are suspended.

2dly. If a certain degree of pressure be made upon the brain, both feeling and voluntary motion cease whilst it continues and return when it is removed.

3dly. As we have evidence that the perceptions and intellect of animals increase in proportion as the brain becomes larger and more complex, so we have reason to conclude that these faculties are connected with that part of the nervous system.

4thly. The conviction which we generally though not constantly experience, that feeling exists in the part which receives impressions, is shewn to be deceptive by the

following facts. If a nerve be irritated midway between the brain and its extremities, severe pain is supposed to be felt in those extremities; and if it supplies muscles, those muscles become convulsed. Thus when a disease forms about the hip joint, or in the loins, many persons have applied poultices to their knees, from a conviction that as the pain was felt in the knee, it was the seat of the disorder. In like manner, persons who have had their limbs amputated, can scarcely believe that they are removed, because of the pain and other sensations they still seem to feel in them. In either of these cases, motions being excited in the middle of nerves, and transmitted to the brain, are attributed to a disordered state of those parts from which such motions have heretofore originated.

If then it be admitted that sensation

exists in the brain, and that volition proceeds from that organ, it necessarily follows that motions must be transmitted to and fro along the nervous chords, whenever they take place. It was formerly supposed that these chords were passive, and might be made mechanically to vibrate, but their want of elasticity and tension, and their pulpy origins and terminations, are circumstances which render such a supposition inadmissible. Physiologists were therefore led to conjecture that the nervous fibrils were tubular, and that they contained a subtile fluid, by means of which such motions were transmitted.

Of the extensive knowledge and high intellectual powers of Baron Haller no one can entertain a doubt; and yet, he could devise no other theory to account for the phænomena of the nervous functions. His opinions have always appear-

ed to me very sensible, and they were accordant to the philosophy of his own times. He says, Si vero, cogitata nostra de ipsa natura spirituum proferre juberemur, activum ad motum, a voluntate & a sensu concipiendum, aptissimum, celerrimum, omne sensuum acie subtilius, tamen hactenus igne & æthere, & electro, & magnetica materie crassius facere elementum, ut et contineri vasis, & a vinculis coerceri aptum sit: & denique manifestum ex cibis nasci & reparare queat.

Mr. Hunter's opinion of a subtile and mobile substance, inhering in the nervous chords, is not essentially different from that of Haller. He does not indeed suppose it to be confined in tubes, neither does the philosophy of the present time require such a supposition, for no one at present will doubt that a subtile substance may be attached to or inhere in a chord

without mechanical confinement. Will not a wire when electrified continue to be so, if surrounded by non-conductors? Experiments made on the limbs of animals with electricity, produced in the manner first explained by Volta, shew that different parts of the body have different conducting powers. Skin and membrane being very bad conductors, and brain, muscle, and blood being remarkably good ones.

The celerity with which motions are transmitted from the tangible extremities of nerves most distant from the brain, and the celerity with which volition is transmitted to the muscles, in consequence of sensations thus induced, are sufficient to convince us that such effects must be produced by the motions of a very mobile substance. It is not necessary to suppose that when such motions are trans-

mitted along the nervous chords, an evident motion of the visible matter of those chords should be induced. Electrical motions take place along a wire without occasioning any visible motion of the metal itself.

Formerly, it was thought that the motions of the nerves that cause sensation, were the effect of an impulse made on their tangible extremities, which was propagated along the chord to the brain. It seems to be an improvement in modern physiology, to attribute sensation to an action begun in the nervous fibrils, in consequence of the stimulation which they suffer from such impulses. This opinion is contended for by Doctor Darwin, in his paper on Ocular Spectra, published in the Philosophical Transactions; and Sir Everard Home has further shewn, that the living principle of nerves has an irritability belonging to it, resembling that

of muscles, and capable of causing a contraction in them when they are divided.*

The opinion that sensation is the consequence of an action begun in and transmitted through the nervous fibrils, assists us in understanding how our sensations may be very vivid from the slightest impulses; such, for instance, as take place in the application of odour to the olfactory nerves, for it is not the impulse, but the consequent action, that is transmitted to the sensorium: and why we may have no sensation from the most violent impulses; for such we cannot but suppose to occur, when a man is shot through the body, or has a limb removed by a cannon ball; occurrences which have however happened without any distinct feeling intimating the event.

* Croonian Lecture.

In supposing a principle of life in nerves, similar to what is conceived to exist in muscles, we might naturally expect to find certain analogies of functions in those organs. The facility, celerity, and accuracy of the nervous actions, seem like those of the muscles to be improved by use; as is exemplified in the quick and correct perceptions of those who are accustomed to exercise their auditory nerves in attending to musical sounds. A train of nervous actions having often taken place they, like similar actions in muscles, become concatenated, and are liable to occur in succession, when one of them is accidentally induced. Both nerves and muscles require temporary respites from action, and are refreshed by sleep.

The supposition of actions occurring in the nerves, explains many circum-

stances connected with diseases. Vehement actions may occur in the tangible extremities of nerves, independent of impulses, and occasion severe pain. This seems to happen in the disease called tic douloureux. Ordinarily, actions beginning in the tangible extremities of nerves, are regularly transmitted to the brain; but in cases of nervous pains, actions sometimes seem to begin in the middle of nerves; and it is probable, that actions beginning in the sensorial extremities of nerves may be productive of illusory sensations, and excite fallacious ideas.

If this theory of nervous actions could be proved, the extent of our knowledge would only lead to this conclusion, that motions of a subtile substance, propagated to and fro in the nervous fibrils, took place in consequence of excitement by

impulses and volition; but from such motions it seems impossible to account for sensation or volition. We can conceive no variety in these motions, but what relates to degree, duration, and succession, and it seems impossible to believe that sensation can be the result of such motions, or that ideas can arise from any succession or train of them. Certain persons will therefore I doubt not continue to think that sensation, remembrance, comparison, judgment, and volition, are properties of some distinct substance.

The essences or primitive parts of what we call matter, are too subtile to be perceived by our senses, and seem even to elude our conceptions. Is it not then most philosophical to acknowledge our ignorance on these points, and to speak of what we do know, the properties of the different species of substances in na-

ture. Thus we seem to be acquainted with the properties of the aggregate forms of that substance which is cognizable to the eye and touch, and which we then call matter; we seem to be assured of the existence, and to know something of the properties, of a subtile substance which pervades all nature; and if we are allowed to know any thing, we surely may be admitted to know the properties of our own minds.

How diversified are our perceptions, how admirably are they adapted to our wants and gratifications! for all beauty of prospect, all melody of sound, all variety of odour, must by the eye of reason be perceived to result from the masses or molecules of surrounding matter, being in various states of motion or of rest; of which circumstances we have notice by the actions they induce in our ner-

vous fibrils. Such variety of perceptions I can only consider as the effect of the peculiar properties of that which feels, remembers, reasons, and wills, and which seems connected with the brain alone.

The conclusion to be drawn from this examination of the functions of the nervous system is curious and interesting. We perceive an exact correspondence between those opinions which result from physiological researches, and those which so naturally arise from the suggestions of reason that some have considered them as intuitive. For most reflecting persons in all ages have believed, and indeed it seems natural to believe, what modern physiology also appears to teach, that in the human body there exists an assemblage of organs, formed of common inert matter, such as we see after death, a principle of life and action, and a sen-

tient and rational faculty, all intimately connected, yet each apparently distinct from the other.

So intimate, indeed, is the connection as to impose on us the opinion of their identity. The body springs and bounds as though its inert fabric were alive; yet have we good reasons for believing that life is distinct from organization. The mind and the actions of life affect each other. Failure or disturbance of the actions of life prevent or disturb our feelings, and enfeeble, perplex, or distract our intellectual operations. The mind equally affects the actions of life, and thus influences the whole body. Terror seems to palsy all its parts, whilst contrary emotions cause the limbs to struggle, and become contracted from energy. Now though these facts may countenance the idea of the identity of mind and

life, yet have we good reasons for believing that they are perfectly distinct. Whilst, therefore, on the one hand, I feel interested in oppugning those physiological opinions which tend to confound life with organization; I would, on the other, equally oppose those which confound perception and intelligence with mere vitality.

In the first lecture I endeavoured to shew that Mr. Hunter's Theory of Life was verifiable, and that it afforded the most rational solution of the cause of irritability, which had hitherto been offered to the public. It now appears that it does not essentially differ from that of the best physiologists, with regard to the explanation it affords of the nervous functions. As it is impossible to review all the phænomena of these functions in a lecture, I shall on the present

occasion merely direct your attention to the consideration of one other subject, which is, the opinions we may be warranted in forming, respecting the connection of irritability and sensibility.

This subject has been the cause of much controversy. Haller maintained that irritability was a distinct property inherent in muscles ; to use his own words, that they had a vis insita, independent of the vis nervea; which opinion has of late received additional corroboration from some experiments of Mr. Brodie. Those who object to this opinion, can, I think, only oppose it on the following grounds. They must contend either that the muscles have a kind of perception of injury which causes them to contract, even though they are unconnected with the brain; or that the nerves are the organs which prepare and supply the muscles with

something which is the cause of irritability.

Concerning the first of these suppositions, that muscles may have a perceptibility of injury, distinct from that which we understand to be feeling, I have to observe, that we can have no idea of sensation but what results from our own experience, which may be defined to be perception attended with consciousness; which kind of sensation is confined to the brain alone. Of any other kind of perception, it is evident we can never form any idea.

If a man's leg be amputated, and by voltaic electricity I excite contraction in its muscles for some hours, how can I know whether they feel or not? We naturally judge of other subjects from ourselves, and knowing that we shrink from

whatever pains us, some persons seem to conclude that the muscles contract because they have been hurt. To the patient who has suffered amputation, such a supposition would seem absurd. He may feel pain when no stimulus is applied to the limb, or he may feel ease when it is. Nay, he continues to feel pain, or sensations, in the limb when it is rotten, or no longer in existence; which seems to shew the integrity of the sentient principle remaining in the brain.

In vegetables, and in some moluscæ, no traces of a nervous system are discoverable, yet the irritability of life is manifest in all. In the ascending series of animals, in proportion as the brain becomes large and complex, we have evidence of the perceptions and intelligence increasing; a circumstance which would lead us to believe that these faculties were connected

with that part of the nervous system. We have also equal reason to believe, that neither such perception nor intelligence is requisite for the mere functions of life, for these appear to be carried on as effectually in animals that have no brains, nay, in those which seem destitute of any nervous system, as in those which possess such organs. Indeed, many of the most vivacious and irritable animals have the least nervous system. The nerves in the lower order of animals, that have no common sensorium, may contribute to produce effects, which, in tracing the ascending series, I have endeavoured to express by the words concurrence of impressions and actions ; because intimations of impressions and actions occurring in one part may be communicated to others by these inter-nunciate chords, as Mr. Hunter called them, in cases where we

are not warranted in supposing there is any sensation such as I have defined.

Assuredly, motion does not necessarily imply sensation; it takes place where no one ever yet imagined there could be sensation. If I put on the table a bason containing a saturated solution of salt, and threw into it a single crystal; the act of crystallization would begin from the point touched, and rapidly and regularly pervade the liquor till it assumed a solid form. Yet I know I should incur your ridicule, if I suggested the idea that the stimulus of the salt had primarily excited the action, or that its extension was the effect of continuous sympathy. If also I threw a spark amongst gun-powder, what would you think were I to represent the explosion as a struggle resentful of injury, or the noise as the clamorous expression of pain?

Now though chemists may solve the cause of these phænomena, physiologists have yet to learn, and probably they never may learn, why certain actions succeed to certain causes in living bodies. Causes which induce muscular or nervous actions in one part do not induce similar actions in another. Both muscles and nerves have peculiar habitudes and modes of action, and require the application of various peculiar excitements. Causes which produce no bad effect upon one person, will have a detrimental influence upon another, and this we say is the result of idiosyncrasy. Thus the odour of a cat, or the effluvia of mutton, the one imperceptible, the other grateful to the generality of persons, has caused individuals to fall on the ground as though bereaved of life, or to have their whole frame agitated by convulsions. Substances which induce disease in one person or animal, do not induce disease in others. That

pain is not the cause of action, is I think evident. Nervous motions, induced by the will, cause our muscles to act, but such motions occasion no sensation in the obedient muscles. When, therefore, we employ the terms in common use of a stimulus being applied, and an action or disease excited, we should remember that neither the infliction of pain, nor absolute injury, is essential to the production of such consequences.

With respect to the second proposition, into which I have resolved the objections that may be made to Haller's opinion of irritability being independent on sensibility, I have only to remark, that the effects of pressure made on nerves, as well as other observations, have induced the general belief that some fluid or energy pervades the nerves for the supply of the body. Pressure on a nerve be-

numbs and paralyzes the parts which it supplies, which regain sensation and motion on the removal of the pressure; yet if irritability exist in vegetables and some animals that have no nervous system, it shews the possibility of irritability being produced without the intervention of nerves.

It has been my object to shew that Mr. Hunter's Theory of Life is a verifiable Theory, and that it affords the most rational explanation of the phænomena of irritability, and of those nervous functions that have been considered. It is, however, impossible in the compass of a lecture, as I have before observed, to review all the phænomena of the nervous functions, which it is necessary to do in order to establish it as a rational Theory. The contemplation of this subject at large, is fitter for meditation in the closet than

for discussion in the lecture-room. I shall, therefore, merely mention by way of exciting attention to some of the phænomena alluded to, that it seems impossible to account for those which Mr. Hunter conconsidered as the effect of sympathies between remote organs, or for those consequences of idiosyncrasy which have been mentioned, upon any other supposition than that of a subtile substance, prone to act, or liable to fail in action, pervading the body, the affections of which can with electrical celerity be propagated throughout the system.

I have further to shew that Mr. Hunter's Theory of Life is adequate to explain the cause of the prevention of putrefaction, and the regulation of temperature. If the vital principle of Mr. Hunter be not electricity, at least we have reason to believe it is of a similar nature, and has the power of regulating electrical

operations. That electricity is the great chemist both in organized and unorganized bodies, will be generally credited; and that the power which combines may also prevent decomposition is too obvious to need discussion. That electricity is capable of augmenting and diminishing the temperature of unorganized matter is well known. Does not Platina wire drop like wax in fusion when it intervenes between the different ends of the voltaic battery? and do not the spherules of rain fall to the ground at midsummer as firmly frozen as in the depth of winter, when they pass through a stratum of air refrigerated by electrical operations? I believe I need say no more on these subjects.

The varying and the strong retention of life by seeds, and some kinds of vegetables and animals, are facts which seem

more satisfactorily solved by Mr. Hunter's Theory of Life than by any other.

Impressed with the difficulties of the task I have undertaken, of giving lectures in the presence of men of superior knowledge and talents, respecting subjects on which every one has formed his own opinions, which of course he thinks correct; though desirous of fulfilling the design of these lectures to the extent of my ability, I feel unable to display the subjects of them in any other way than that to which I have been accustomed. Thinking as Mr. Hunter taught, with regard to life and its functions, in health and disorder, I must use his language as expressive of the phænomena we observe. That an attention to the sympathies of parts and organs is necessary to our understanding disorder and disease, I shall hereafter endeavour to shew. That Mr. Hunter

did observe these sympathies in a manner and to an extent that surprized most professional men, is well known to all those who were present at his lectures on this subject. Their surprize was indeed natural, because they were not then fully acquainted with his views and motives.

I mention these things, because I am aware that there are some who say sympathy is a term without any direct meaning, and that all which Mr. Hunter said on the subject of life, explains nothing. What Mr. Hunter meant, I believe I understand; what persons of different sentiments, whom I acknowledge possess great information and ability, mean, when they talk in this manner, I am not so well able to discover. They seem to deny that life can be any thing which may not be seen or felt. They seem to wish us to believe that they have that phi-

losophical turn of mind which exempts them from vulgar prejudices, and that no Theory appears to them satisfactory, neither do they propose any for our adoption.

Thinking being inevitable, we ought, as I said in the beginning, to be solicitous to think correctly. Opinions are equally the natural result of thought, and the cause of conduct. If errors of thought terminated in opinions, they would be of less consequence; but a slight deviation from the line of rectitude in thought, may lead to a most distant and disastrous aberration from that line in action. I own I cannot readily believe any one who tells me, he has formed no opinion on subjects which must have engaged and interested his attention. Persons both of sceptical and credulous characters form opinions, and we have in general some principal opinion, to which we connect the rest, and to which we make them

subservient; and this has a great influence on all our conduct. Doubt and uncertainty are so fatiguing to the human mind, by keeping it in continual action, that it will and must rest somewhere; and if so, our enquiry ought to be where it may rest most securely and comfortably to itself, and with most advantage to others? In the uncertainty of opinions, wisdom would counsel us to adopt those which have a tendency to produce beneficial actions.

If I may be permitted to express myself allegorically, with regard to our intellectual operations, I would say, that the mind chooses for itself some little spot or district where it erects a dwelling, which it furnishes and decorates with the various materials it collects. Of many apartments contained in it, there is one to which it is most partial, where it chiefly reposes,

and where it sometimes indulges its visionary fancies. At the same time it employs itself in cultivating the surrounding grounds, raising little articles for intellectual traffic with its neighbours, or perhaps some produce worthy to be deposited amongst the general stores of human knowledge.

Thus my mind rests at peace in thinking on the subject of life, as it has been taught by Mr. Hunter; and I am visionary enough to imagine, that if these opinions should become so established as to be generally admitted by philosophers, that if they once saw reason to believe that life was something of an invisible and active nature superadded to organization; they would then see equal reason to believe that mind might be superadded to life, as life is to structure. They would then indeed still farther perceive how mind and matter

might reciprocally operate on each other by means of an intervening substance. Thus even would physiological researches enforce the belief which I may say is natural to man; that in addition to his bodily frame, he possesses a sensitive, intelligent, and independent mind: an opinion which tends in an eminent degree to produce virtuous, honorable, and useful actions.

THE END.

H. Bryer, Printer, Bridge-Street, Blackfriars, London.